

A survey of hydrous species and concentrations in igneous feldspars

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ABSTRACT

The hydrous components in 85 feldspars from various igneous environments spanning the range of naturally occurring compositions were examined with infrared spectroscopy. The feldspars contain structural OH (0–512 ppm H₂O), H₂O (0–1350 ppm H₂O), and NH₄⁺ (0–1500 ppm NH₄⁺) groups as well as fluid inclusions and alteration products. Although composition and structure do influence the type of hydrous species that can be incorporated into a particular feldspar mineral, the concentration of these species is not controlled by major-element composition. Coarse perthitic microclines have a heterogeneous distribution of hydrous species, and contain H₂O or NH₄⁺ in K-rich lamellae and fluid inclusions in Na-rich areas. The structural OH in plagioclase feldspars is not associated with twin boundaries or exsolution lamellae. All of the possible structural hydrous species are found in pegmatite feldspars, whereas volcanic feldspars contain only structural OH. The variation in OH concentration within a given feldspar composition suggests that fluids in the geologic environment play a role in determining the hydrogen concentration of each sample. The vast majority of plutonic feldspars have undergone partial or total equilibration with meteoric fluids during low-temperature (400–150 °C) hydrothermal exchange, obliterating any structural hydrogen and creating substantial concentrations of fluid inclusions (up to 4000 ppm H₂O) in the exchanged regions. The amount of water stored as fluid inclusions within feldspars in the upper crust (1 × 10¹⁹ kg) is small compared to the 1.35 × 10²¹ kg of water in the oceans, but is roughly equivalent to the reservoir of water stored in hydrous minerals in the upper crust.